

**REMARKS**

**Status of the Claims**

Claims 1-3, 5, 7 and 9-23 are pending in this application, the independent claims being claims 1 and 9. By this Amendment, claims 4, 6 and 8 are canceled, claims 1-3, 5, 7, 9, 12, 13, 16 and 17 are amended, and claims 21-23 are newly presented. Claims 10 and 11 previously were withdrawn from consideration in the present application.

**Summary of the Official Action**

In the Official Action, claims 1- 9 and 12-20 were rejected under 35 U.S.C. 102(b), as anticipated by U.S. Patent No. 5,583,378 (Marrs); claims 1-4, 9 and 12-20 were rejected under 35 U.S.C. 103(a), as unpatentable over U.S. Patent No. 5,905,633 (Shim) in view of U.S. Patent No. 6,021,563 (Heo); and claims 1-9 and 12-20 further were rejected under 35 U.S.C. 103(a), as unpatentable over the Shim '633 patent in view of the Marrs '378 patent.

Reconsideration and withdrawal of the rejections respectfully is requested in view of the above amendments and the following remarks.

**Claim Amendment**

The rejections of the claims over the cited art respectfully are traversed. Nevertheless, without conceding the propriety of the rejections, claims 4, 6 and 8 have been canceled, claims 1-9 and 12-17 have been amended more clearly to recite various novel features of the claimed invention, with particular attention to the Examiner's comments, and claims 21-23 have been added to provide Applicant with additional scope of protection commensurate with the disclosure. Support for the amendments may be found in the original application. No new matter has been added.

Moreover, Applicant submits that the amended claims recite more clearly various novel features of the claimed invention not previously presented and/or considered on appeal.

**Claimed Invention****Claim 1**

The present invention relates to a novel method of fabricating a semiconductor device. In one aspect, as recited in claim 1, the claimed invention relates to a method of fabricating a semiconductor device comprising, in order, the following steps, (a) attaching a plurality of semiconductor chips to a continuous semiconductor substrate tape in a reel-to-reel transport system; (b) cutting the continuous semiconductor substrate tape to obtain individual semiconductor substrates, each including a single semiconductor chip; and then (c) providing a plurality of external terminals on each of the individual semiconductor substrates. As disclosed in greater detail in the present application, this process, including a cutting the continuous semiconductor substrate tape in a reel-to-reel transport system to form of plurality of individual semiconductor substrates, each including a single semiconductor chip, prior to providing external terminals on each of the individual semiconductor substrates, provides a simple, flexible, reliable and cost effective substrate device manufacturing process.

In another aspect, as recited in dependent claim 2, step (a) further comprises attaching a reinforcing member to the continuous semiconductor substrate tape at positions corresponding to each of the semiconductor chips. In this aspect, as shown for example in Figs. 3A and 3B, this feature provides a reinforcing function to the relatively flexible semiconductor substrate tape about the semiconductor chip, thereby stabilizing the semiconductor device assembly and reducing the risk of warping in the reel-to-reel transport system.

In another aspect, as recited in dependent claims 12-13, the claimed invention variously relates to the method of claim 1, wherein the semiconductor chip is bonded to the continuous semiconductor tape in a face-up configuration (claim 12), and electrodes of the

semiconductor chips and leads formed on the continuous semiconductor substrate tape are electrically connected with wires (claim 13).

In other aspects, as recited in dependent claims 14-17, the method further comprises attaching a heat radiating member to each of the semiconductor chips (claims 14, 15), and in particular attaching the heat radiating member in step (a) - prior to the cutting step (claims 16, 17).

In additional aspects, dependent claims 18-20 relate to a semiconductor device made by the method of claim 1, and to a circuit board and an electronic apparatus including the semiconductor device of claim 18, respectively.

#### Claim 9

In another aspect, as recited in independent claim 9, the claimed invention relates to a method of fabricating a semiconductor device comprising, in order, the steps of (a) providing a continuous semiconductor substrate tape in a reel-to-reel transport system, including forming a plurality of device holes in the continuous semiconductor substrate tape and forming leads on the continuous semiconductor substrate tape, where end portions of the leads project into respective device holes; (b) attaching a reinforcing member to the continuous semiconductor substrate tape at positions corresponding to the respective device holes, (c) attaching a plurality of semiconductor chips to the continuous semiconductor substrate tape, including disposing each of the semiconductor chips within a respective one of the device holes, and bonding the leads with electrodes of the semiconductor chips, (d) cutting the continuous semiconductor substrate tape to obtain individual semiconductor substrates, and (e) providing a plurality of external terminals on each of the individual semiconductor substrates.

In another aspect, as recited in dependent claim 3, the method further comprises the step of cutting the continuous semiconductor substrate tape (including plural individual semiconductor substrates) into regions, each including one semiconductor chip.

In a similar aspect, as recited in dependent claim 5, the method further comprises the step of cutting the continuous semiconductor substrate tape (including plural individual semiconductor substrates) into regions, each including *two or more* semiconductor chips (prior to providing the plurality of terminals to the individual semiconductor substrates). In a further similar aspect, as recited in dependent claim 7, the method further comprises cutting each of these regions into subregions, each including a single semiconductor chip after step (e) is performed - that is, after the external terminals are connected to the individual semiconductor substrates.

In another aspect, as recited in new claim 21, the method further comprises attaching a heat radiating member to each of the semiconductor chips.

In other aspects, as recited in claims 22-23, the claimed invention relates to a semiconductor device fabricated by the method as defined in claim 9, and an electronic apparatus including the semiconductor device as defined in claim 22.

### **Prior Art Distinguished**

Applicant submits that the prior art fails to anticipate the claimed invention. Moreover, Applicant submits that there are differences between the subject matter sought to be patented and the prior art, such that the subject matter taken as a whole would not have been obvious to one of ordinary skill in the art at the time the invention was made. In particular, Applicant submits that the cited art fails to disclose or suggest the above-described specific combination of method steps.

Claim 1

**The Marrs '378 patent** relates to a ball grid array integrated circuit package with thermal conductor, and discloses a method of manufacturing ball grid arrays. However, Applicant submits that the Marrs '378 patent fails to disclose or suggest the above-discussed method of the claimed invention. Rather, Applicant submits that the Marrs '378 patent particularly is directed to an improved semiconductor device assembly having a thermal conductor that covers the entire outer surface of an interconnection substrate, and generally is directed to a method for obtaining such a device. The Marrs '378 patent describes in detail preferred embodiments/methods of manufacturing such semiconductor devices including preparing a panel having a grid of a plurality of semiconductor device assemblies. In these methods (preferred embodiments), a panel including a plurality of semiconductor device assemblies first is cut into strips each including a linear array of a plurality of semiconductor device assemblies, and then into individual semiconductor devices. The Marrs '378 patent also states that the devices may be made from a strip including a linear array of a plurality of semiconductor device assemblies, or that such devices may be made individually. However, the Marrs '378 patent does not disclose specific steps for making semiconductor devices using either such method, because the Marrs '378 patent teaches that such methods are not cost effective. Moreover, although the Marrs '378 patent in two places states that those skilled in the art will appreciate that the disclosed semiconductor device structures may be manufactured by other known methods, such as reel-to-reel printed circuit board manufacturing, nowhere does the Marrs '378 patent disclose or describe any details of such a reel-to-reel printed circuit board manufacturing system or method.

The Board's Decision on Appeal is consistent with Applicant's arguments herein. In its Decision, the Board recognized Applicant's argument that, although the Marrs '378 patent disclosure is directed to the assembly of individual ball grid array packages, the methods

disclosed in detail start with 9" x 12" panels that are not used in conjunction with a reel-to-reel transport system. The Board notes that the Marrs '378 patent teaches that a reel-to-reel transport system may be used to manufacture ball grid arrays. However, Applicant submits that the Board's Decision also recognizes that the Marrs '378 patent does not anticipate the above-discussed combination of features/steps recited in the claimed method, including cutting a continuous substrate tape on a reel-to-reel transport system to obtain individual semiconductor substrates, *each including a single semiconductor chip*, prior to providing a plurality of external terminals on each of the individual semiconductor substrates, as disclosed in the present application and recited in claim 1.

Applicant submits that the Board decision acknowledges that a reel-to-reel system method as disclosed in the present application and recited in amended claim 1 is different from the method steps disclosed in the Marrs '378 patent. In discussing the Marrs '378 patent disclosure with respect to prior appealed claim 1, the Board determined:

"Then, in the next column, column 10, the Marrs '378 patent describes a stage of production wherein panels comprise empty ball grid array package units and the panels are formed into **strips** of package units. The **strips** are punched or routed out of the panel (column 10, lines 15-17). Thereafter, the **strips**, comprising the package units, are cut out from the substrate. Once these **strips** are created, integrated circuit chips 'are wire bonded for electrical connection' (column 10, lines 22-23). Further, if solder balls are required, they are applied 'at this stage' (column 10, lines 26-27). Marrs goes on to state that individual units 270G 'are **then** marked and punched out, thereby producing individual ball grid array packages 200 including integrated circuit chips 202 . . . in a cost effective and efficient manner, 'and **this step is performed after the application of the external terminals, i.e., solder balls . . .**' (emphasis added).

Thus, as recognized in the Board's Decision, nowhere does the Marrs '378 patent disclose or suggest a method of fabricating a semiconductor device including the combination of steps of (a) attaching a plurality of semiconductor chips to a continuous semiconductor substrate tape,

(b) cutting the continuous semiconductor substrate tape to obtain individual semiconductor substrates, each including a single semiconductor chip, and (c) providing a plurality of external terminals on each of the individual semiconductor substrates after step (b), as disclosed in the present application and recited in amended claim 1.

Applicant submits that **the Shim '633 patent** fails to remedy the deficiencies of the Marrs '378 patent. The Shim '633 patent relates to a ball grid array semiconductor package using a metal carrier ring as a heat spreader, and discloses a method of manufacturing ball grid array semiconductor packages. However, Applicant submits that the Shim '633 patent fails to disclose or suggest at least the above-discussed features of the claimed invention. In fact, in its Decision, the Board agreed with Applicant's arguments on appeal that the Shim '633 patent failed to obviate the claimed method of manufacturing a semiconductor device, and stated that the Shim '633 patent merely is cumulative to the Marrs '378 patent with respect to the claimed method. Applicant submits that the Shim '633 patent is no more pertinent to the method steps now recited in amended claim 1. As acknowledged by the Examiner in the Official Action, the Shim '633 patent fails to disclose providing the plurality of external terminals on each of the individual semiconductor substrates after step (b). Nowhere does the Shim '633 patent disclose or suggest a method of fabricating a semiconductor device including the combination of steps of (a) attaching a plurality of semiconductor chips to a continuous semiconductor substrate tape, (b) cutting the continuous semiconductor substrate tape to obtain individual semiconductor substrates, each including a single semiconductor chip, and (c) providing a plurality of external terminals on each of the individual semiconductor substrates after step (b), as disclosed in the present application and recited in claim 1. Nor is the Shim '633 patent believed to add anything to the Marrs '378 patent that would make obvious the claimed invention.

Applicants submit that **the Heo '563 patent** fails to remedy the deficiencies of the above-cited art. The Heo '563 patent relates to marking bad printed circuit boards for semiconductor packages, and discloses a method for manufacturing ball grid array semiconductor devices, and discloses a fabrication method including a chip mounting step, a wire bonding step, a resin seal molding step, a singulation step, and a solder ball fusing step, carried out in that order (column 6, lines 1-5). However, Applicant submits that the Heo '563 patent fails to disclose or suggest at least the above-discussed features of the claimed invention. Nowhere does the Heo '563 patent disclose or suggest a method using a reel-to-reel transport system and including a continuous semiconductor substrate tape, as disclosed in the present application and recited in claim 1. Rather, the Heo '563 patent is directed to a method of manufacturing a printed circuit board strip 10. Nor is the Heo '563 patent believed to add anything to the Marrs '378 patent and/or the Shim '633 patent that would make obvious the claimed invention.

#### Claim 9

Applicant submits that the cited art, alone or in any combination, also fails to disclose or suggest the specific combination of features of amended independent claim 9. In particular, Applicant submits that the cited art fails to disclose or suggest the method of fabricating a semiconductor device comprising, in order, the steps of (a) providing a continuous semiconductor substrate tape in a reel-to-reel transport system, including forming a plurality of device holes in the continuous semiconductor substrate tape and forming leads on the continuous semiconductor substrate tape, where end portions of the leads project into respective device holes; (b) attaching a reinforcing member to the continuous semiconductor substrate tape at positions corresponding to the respective device holes, (c) attaching a plurality of semiconductor chips to the continuous semiconductor substrate tape, including disposing each of the semiconductor chips within a respective one of the device holes, and



bonding the leads with electrodes of the semiconductor chips, (d) cutting the continuous semiconductor substrate tape to obtain individual semiconductor substrates, and (e) providing a plurality of external terminals on each of the individual semiconductor substrates, as disclosed in the present application and recited in claim 9. As noted above, the Marrs '378 patent and the Heo '563 patent do not disclose specific details regarding a method of manufacturing a semiconductor device using a reel-to-reel transport system. The Shim '633 patent relates to a method using a metal substrate ribbon, not a semiconductor substrate tape, as disclosed in the present application and recited in the claims.

For the above reasons, Applicant submits that claims 1 and 9 are allowable over the cited art.

Claims 2, 3, 5, 7 and 12-23 depend from claims 1 and 9, and are believed allowable for the same reasons. Moreover, each of these dependent claims recites additional features in combination with the features of its respective base claim, and is believed allowable in its own right. Individual consideration of the dependent claims respectfully is requested.

#### **Request For Examiner Interview**

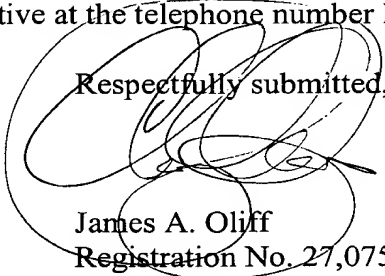
If the Examiner is not persuaded by the amendments and remarks, Applicant respectfully requests that the Examiner contact Applicant's attorney to schedule an interview to discuss Applicant's remarks and further distinguish the claimed invention over the cited art.

#### **Conclusion**

Applicant believes that the present Amendment is responsive to each of the points raised by the Examiner in the Official Action, and submits that the application is in condition for allowance. Favorable consideration of the claims and passage to issue of the present application at the Examiner's earliest convenience earnestly are solicited.

Should the Examiner believe that anything further would be desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact the Applicant's undersigned representative at the telephone number listed below.

Respectfully submitted,

  
James A. Oliff  
Registration No. 27,075

Christopher Philip Wrist  
Registration No. 32,078

JAO:CPW

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**OLIFF & BERRIDGE, PLC**  
**P.O. Box 19928**  
**Alexandria, Virginia 22320**  
**Telephone: (703) 836-6400**

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